**Implementation and Integration of a Finite Element Model into the Bone Remodeling Model to Characterize Skeletal Loading**

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### Background

- The Digital Astronaut project is developing a bone physiology model to predict changes in bone mineral density over the course of a space mission, by predicting bone loss due to exposure to a microgravity environment, and by predicting bone maintenance due to mechanical stimulus generated by exercise countermoves. These predictions will be used to inform exercise device efficacy as well as develop exercise protocols that maintain healthy bone mineral density during long duration spaceflight missions.
- The mechanical stimulus sensed by the bone and the stresses that are applied to the bone are important factors for bone remodeling.
- The stresses are dependent on the type of exercise and vary across the bone structure due to geometry.
- One of the primary regions of concern for bone loss in spaceflight is the proximal femur.

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### INTRODUCTION

- **Current GUI for running Bone Remodeling Model**

- **New FEM Description**
  - An anonymous CT scan was supplied by JSC and an FEM was created directly from the scan.
  - The DICOM image stack is made of cubic voxels which can be converted to hexahedral elements using voxel size dimensions of 3mm.
  - Phantom Tube Calibration values are used to determine the bone density of selected voxels.
  - Modulus of elasticity is calculated using ash density and bone volume fraction relationships [2].

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### METHODS

- **Current GUI for creating FEM directly from CT scan**

- **Flow of CT data into Bone Remodeling**

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### REFERENCES

3. Orthoload [http://www.orthoload.com/]